

FORM PTO-1390 (REV 11-98)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER CELA:082	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U.S. APPLICATION NO. (if known) (37 CFR 1.51) 09/868182	
INTERNATIONAL APPLICATION NO. PCT/FR99/03066		INTERNATIONAL FILING DATE 9 December 1999		PRIORITY DATE CLAIMED 9 December 1998	
TITLE OF INVENTION PYROTECHNICALLY UNLOCKABLE MECHANICAL DEVICE IMPLEMENTING A PISTON					
APPLICANT(S) FOR DO/EO/US Jean-Paul VIDOT; Patrice CHEMIERE					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.					
<p>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</p> <p>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</p> <p>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>b. <input type="checkbox"/> have been transmitted by the International Bureau.</p> <p>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p>d. <input type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> <p><b>Items 11. to 16. below concern document(s) or information included:</b></p> <p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.</p> <p><input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</p> <p>14. <input type="checkbox"/> A substitute specification.</p> <p>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>16. <input checked="" type="checkbox"/> Other items or information: Form PCT/IPEA/416; 409.</p>					

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PARKHURST & WENDEL

09/7868182

JUL 15 2001

17. ☒ The following fees are submitted:**BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):**

Neither international preliminary examination fee (37 CFR 1.482)  
nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO  
and International Search Report not prepared by the EPO or JPO ..... \$1,000.00

International preliminary examination fee (37 CFR 1.482) not paid to  
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\$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total claims	29 - 20 =	9	X \$18.00
Independent claims	1 - 3 =	0	X \$80.00
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$270.00

\$ 162.00

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**TOTAL OF ABOVE CALCULATIONS =**

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c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any  
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**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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25,177  
REGISTRATION NUMBER

REGISTRATION NUMBER

ATTY. DOCKET NO.: CELA:082

09/868182  
JC03 Rec'd PCT/FTC 15 JUN 2001

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Jean-Paul VIDOT et al.

Serial No.: New Application

Filed: June 15, 2001

For: PYROTECHNICALLY UNLOCKABLE MECHANICAL  
LINKING DEVICE IMPLEMENTING A PISTON

PRELIMINARY AMENDMENT

Commissioner for Patents  
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified application,  
please enter the following specification changes as noted below:

IN THE CLAIMS:

Please amend claims 5, 7, 10-12, 14, 16-17, 20-23 and 28-29  
below:

5. (Amended) An unlockable mechanical linking device  
according to Claim 3, wherein the pyrotechnic component (23) is  
integral with the piston (21).

7. (Amended) An unlockable mechanical linking device according to Claim 5, wherein the piston (21) incorporates a second cylindrical seat (29) of a diameter less than that of the cylindrical surface (22) or first seat retaining the tips, said second seat being positioned opposite the bore (20) delimited by the tips (15) when the piston (21) is translated under the action of the gas pressure, thereby allowing the tips (15) to bend in the direction of the piston (21), such bending allowing the external profile (18) of the tips (15) to be disengaged from its matching profile (19).

10. (Amended) An unlockable mechanical linking device according to Claim 3, wherein the cylindrical surface (22), or first piston seat retaining the tips incorporates a rib (33) cooperating with a circular groove arranged on the cylindrical surface of the internal bore (20) so as to ensure the axial positioning of the piston (21) in its retention position.

11. (Amended) An unlockable mechanical linking device according to Claim 3, wherein it incorporates at least three deformable tips (15) evenly spaced angularly.

12. (Amended) An unlockable mechanical linking device according to Claim 2, wherein the first of the mechanical elements carrying the deformable tips (15) comprises a threaded part (68) forming the shaft of a screw, the second mechanical element constituting a head (67) for said screw.

14. (Amended) An unlockable mechanical linking device according to Claim 12, wherein the axial bore (20) receiving the piston (21) is arranged in the screw shaft (68).

16. (Amended) An unlockable mechanical linking device according to Claim 14, wherein the piston (21) incorporates a ring-shaped sealing ring (73) co-operating with an internal cylindrical surface of the bore (20).

17. (Amended) An unlockable mechanical linking device according to Claim 13, wherein the screw head (67) comprises a body (70) delimiting an internal chamber (74) that is obturated on one side by the screw shaft (68) and on the other by a plug (75) that presses on a peripheral protuberance (78) of the pyrotechnic component (23), a spacer ring (79) surrounding an end of the

pyrotechnic component (23) and incorporating a first abutment surface (80) co-operating with the protuberance (78) on the component and a second abutment surface (81) for an end (82) of the screw shaft (68) so as to avoid any contact between it and the pyrotechnic component (23) when the plug (75) is mounted.

20. (Amended) An unlockable mechanical linking device according to Claim 18, wherein the jaws (45) are held in contact with the piston (21) by at least one flexible ring (46).

21. (Amended) An unlockable mechanical linking device according to Claim 18, wherein the piston (21) incorporates translation stop means (47) ensuring its immobilization with respect to the first mechanical element, such stop means being fractured when the pyrotechnic component (23) is ignited.

22. (Amended) An unlockable mechanical linking device according to Claim 18, wherein the pyrotechnic component (23) is integral with the first mechanical element.

23. (Amended) An unlockable mechanical linking device according to Claim 19, wherein the second mechanical element is

formed by a nut (36) co-operating with the threaded profile of the jaws (45).

28. (Amended) An unlockable mechanical linking device according to Claim 24, wherein the groove (56) is made in a ring (58) that is made integral with the second mechanical element (49) by crimping a band (59).

29. (Amended) An unlockable mechanical linking device according to Claim 1, wherein the first mechanical element is integral with one end of a rod of a master brake cylinder for a vehicle and the second mechanical element is integral with a brake pedal.

#### REMARKS

Claims 1-29 remain pending herein. Claims 5, 7, 10-12, 14, 16-17, 20-23 and 28-29 have been amended hereby.

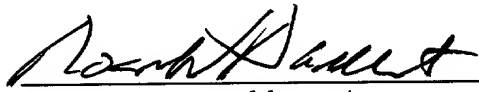
This Preliminary Amendment is submitted to eliminate multiply dependent claims from the above-identified application.

Examination of this application on its merits is respectfully requested.

Respectfully submitted,

PARKHURST & WENDEL, L.L.P.

June 15, 2001  
Date

  
Roger W. Parkhurst  
Registration No. 25,177

Attachment:

Mark Up of Amended Claims

RWP/ame

Attorney Docket No. CELA:082

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5. An unlockable mechanical linking device according to ~~one of Claims 3 or 4~~ Claim 3, wherein the pyrotechnic component (23) is integral with the piston (21).

6. An unlockable mechanical linking device according to  
5 Claim 5, wherein the cylindrical bore (20) delimited by the tips (15) is extended by a chamber (27) intended to receive the gas pressure generated by igniting the pyrotechnic component (23).

7. An unlockable mechanical linking device according to  
10 ~~one of Claims 5 or 6~~ Claim 5, wherein the piston (21) incorporates a second cylindrical seat (29) of a diameter less than that of the cylindrical surface (22) or first seat retaining the tips, said second seat being positioned opposite the bore (20) delimited by the tips (15) when the  
15 piston (21) is translated under the action of the gas pressure, thereby allowing the tips (15) to bend in the direction of the piston (21), such bending allowing the external profile (18) of the tips (15) to be disengaged from its matching profile (19).

20 8. An unlockable mechanical linking device according to Claim 7, wherein the second cylindrical seat (29) is delimited on one side by a collar (30) guiding the piston (21) with respect to an internal cylindrical surface (28) of the chamber (27).

25 9. An unlockable mechanical linking device according to Claim 8, wherein, after the piston (21) has translated, the collar (30) is housed in a groove (31) arranged at one end of the chamber (27).

10. An unlockable mechanical linking device according  
30 ~~to one of Claims 3 to 9~~ Claim 3, wherein the cylindrical surface (22), or first piston seat retaining the tips incorporates a rib (33) co-operating with a circular groove arranged on the cylindrical surface of the internal bore (20) so as to ensure the axial positioning of the piston  
35 (21) in its retention position.

11. An unlockable mechanical linking device according  
to ~~one of Claims 3 to 10~~ Claim 3, wherein it incorporates

**12.** An unlockable mechanical linking device according to ~~one of Claims 2 to 4~~ Claim 2, wherein the first of the mechanical elements carrying the deformable tips (15) comprises a threaded part (68) forming the shaft of a screw, the second mechanical element constituting a head (67) for said screw.

14. An unlockable mechanical linking device according to ~~one of Claims 12 or 13~~, Claim 12, wherein the axial bore (20) receiving the piston (21) is arranged in the screw shaft (68).

20        **16.** An unlockable mechanical linking device according to ~~one of Claims 14 or 15~~ Claim 14, wherein the piston (21) incorporates a ring-shaped sealing ring (73) co-operating with an internal cylindrical surface of the bore (20).

18. An unlockable mechanical linking device according to Claim 2, wherein the locking means comprise at least two

18. An unlockable mechanical linking device according to Claim 2, wherein the locking means comprise at least two

jaws (45) each having a profile co-operating with a matching profile integral with the second mechanical element, each jaw (45) being able to move radially in a radial housing (44) integral with the first element so as to be engaged in or disengaged from the matching profile, such jaws being held in the locking position by the piston (21).

19. An unlockable mechanical linking device according to Claim 18, wherein the external profile of the jaws (45) is a threaded profile.

20. An unlockable mechanical linking device according to ~~one of Claims 18 or 19~~ Claim 18, wherein the jaws (45) are held in contact with the piston (21) by at least one flexible ring (46).

21. An unlockable mechanical linking device according to ~~one of Claims 18 to 20~~ Claim 18, wherein the piston (21) incorporates translation stop means (47) ensuring its immobilization with respect to the first mechanical element, such stop means being fractured when the pyrotechnic component (23) is ignited.

22. An unlockable mechanical linking device according to ~~one of Claims 18 to 21~~ Claim 18, wherein the pyrotechnic component (23) is integral with the first mechanical element.

23. An unlockable mechanical linking device according to ~~one of Claims 19 to 22~~ Claim 19, wherein the second mechanical element is formed by a nut (36) co-operating with the threaded profile of the jaws (45).

24. An unlockable mechanical linking device according to Claim 1, wherein the locking means are formed by at least two balls (48) that are housed in holes (50) arranged in a tubular sleeve (51) integral with the first (10) of the mechanical elements and co-operating with a groove (56) integral with the second mechanical element (49), the balls (48) being held in place by the piston (21), which is positioned inside the tubular sleeve (51) and coaxial to it.

25. An unlockable mechanical linking device according to Claim 24, wherein the piston (21) incorporates a cylindrical seat (62) of the same diameter as the internal diameter of the sleeve, said cylindrical seat being located  
5 opposite the holes (50) in the sleeve thanks to positioning means (63).

26. An unlockable mechanical linking device according to Claim 25, wherein the positioning means comprise a shearable plate (63) integral with the piston (21) and  
10 pressing on a front end of the sleeve.

27. An unlockable mechanical linking device according to Claim 26, wherein it incorporates a chamber (64) in which the gases generated by the pyrotechnic component (23) develop, said chamber arranged at one end of a head (52)  
15 integral with the second mechanical element (49) and obturated by the shearable plate (63).

28. An unlockable mechanical linking device according to ~~one of Claims 24 to 27~~ Claim 24, wherein the groove (56)  
20 is made in a ring (58) that is made integral with the second mechanical element (49) by crimping a band (59).

29. An unlockable mechanical linking device according to ~~one of Claims 1 to 11 or 24 to 28~~ Claim 1, wherein the  
25 first mechanical element is integral with one end of a rod of a master brake cylinder for a vehicle and the second mechanical element is integral with a brake pedal.

6/PRF

PYROTECHNICALLY UNLOCKABLE MECHANICAL LINKING DEVICE  
IMPLEMENTING A PISTON

The technical scope of the present invention is that of  
5 mechanical linking devices between a first and second  
mechanical element, such devices being pyrotechnically  
unlockable.

Such devices are known notably in the field of  
automobile safety devices.

10 For example, patent DE19515852 discloses a device  
permitting two ends of a control rod of a master automobile  
brake cylinder to be pyrotechnically separated. Such a  
separation occurs in the event of an accident so as to  
avoid the brake pedal impacting on the driver's ankles.

15 The separation device disclosed by this document  
implements a pyrotechnic charge arranged in a housing  
provided in the rod or else in a coupling sleeve between  
two elements forming the rod.

20 Separation devices are also known that implement what  
is commonly known as explosive bolts. Patent DE19515852  
also discloses this solution, which is classically employed  
in separation devices used on ballistic or aeronautic  
vehicles.

The disadvantage of these solutions lies in that they  
25 are based on the high explosive effect of a pyrotechnic  
charge. Indeed, one or several primary explosives are used  
possibly in association with one or several secondary  
explosives or energetic but highly confined substances.

However, primary explosive are sensitive materials,  
30 which are thus difficult or hazardous to implement.

So as to ensure the fracture of mechanical support  
parts, the quantities of pyrotechnic charge necessary are  
also substantial (>100 mg), thereby further increasing the  
risks and the cost.

35 Known explosive bolts or other high explosive systems  
are thus unsuited to civil applications, notably in the  
area of the automobile.

Moreover, known bolts constitute locking means that are inserted transversally with respect to the elements to be joined. When the bolt is ignited, there is a risk of fragments of it remaining caught in the different elements  
5 thereby perturbing their detachment or separation. The separation effort of the two elements is thus non-reproducible and the device is not reliable enough unless an unacceptably large quantity of explosive is used.

Another device is also known by patent DE19617372 that  
10 allows two ends of a control rod for a master automobile brake cylinder to be pyrotechnically separated.

In this device the master cylinder rod is made integral in translation with the control pedal by means of a ring placed in a groove. This ring is expelled by the tensile or  
15 compressive forces exerted on the rod and it is held in the locking position by retention means that are formed by a piston pushed by a spring.

So as to ensure separation, a pyrotechnic charge is ignited that generates gases acting on the piston against  
20 the action of a spring.

The gases are also directed towards a chamber where they exert a force tending to separate the elements to be unlocked.

Such a device has a first disadvantage in that its  
25 structure is complicated and comprises numerous mobile parts and notably springs whose mechanical characteristics are likely to deteriorate over time.

This structure is thus likely to become stuck, and it also implements a large quantity of pyrotechnic composition  
30 acting notably on the mechanical elements to be unlocked so as to release the locking ring.

The gas generator is ring-shaped and is thus difficult to manufacture and integrate.

Moreover, as the effect of the gases is to act directly  
35 on the locking means, this results in a total loss of the possibility of acting on the master cylinder rod in the event of the pyrotechnic component being inadvertently ignited.

In the absence of an accident context, the triggering of the device results in the total loss of the braking capability.

The aim of the invention is to propose a  
5 pyrotechnically ununlockable mechanical linking device for two mechanical elements that does not suffer from such drawbacks.

The pyrotechnically ununlockable mechanical linking device according to the invention is simple, compact and  
10 inexpensive in structure. It is simple to implement and permits the use of only a reduced quantity of pyrotechnic composition, such composition possibly being devoid of any primary explosive at all. In practical terms, the mass of composition alone contained in a pyrotechnic igniter for  
15 automobile safety systems can be used.

A standard pyrotechnic igniter can moreover be easily integrated inside the device according to the invention and this with no modification to its structure.

Additionally, the device according to the invention is  
20 reliable and ensures good reproducibility of the separation efforts of the mechanical elements.

The invention thus relates to a pyrotechnically ununlockable mechanical linking device between a first and second mechanical element, said first and second elements  
25 likely to be subjected to tensile and/or compressive force along an axis, said device comprising at least one pyrotechnic component and at least one locking means linking the two mechanical elements along at least one axis, said locking means able to be released when the  
30 mechanical elements are subjected to tensile and/or compressive forces along said axis and held in the locking position by retention means that are released by the pressure of gases generated by igniting the pyrotechnic component, device wherein the retention means comprise a  
35 piston able to slide in an axial bore under the effect of the gas pressure generated by the pyrotechnic composition, the locking means being in contact with the piston at its

external cylindrical surface, which ensures their retention in the locking position.

According to a particular embodiment, the locking means are linked in translation with a first of the mechanical elements and comprise at least one profile co-operating with a matching profile integral with a second of the mechanical elements, the locking means also delimiting at least partially the axial bore in which the piston can slide.

The locking means can comprise at least two deformable tips integral with the first of the mechanical elements and each comprising at least one profile co-operating with a matching profile integral with the second mechanical element, such tips delimiting the internal cylindrical bore receiving the piston.

The tips will advantageously have conical external profiles.

The pyrotechnic component can be integral with the piston.

The cylindrical bore delimited by the tips can be extended by a chamber intended to receive the gas pressure generated by igniting the pyrotechnic component.

The piston may also incorporate a second cylindrical seat of a diameter less than that of the cylindrical surface or first seat retaining the tips, said second seat being positioned opposite the bore delimited by the tips when the piston is translated under the action of the gas pressure, thereby allowing the tips to bend in the direction of the piston, such bending allowing the external profile of the tips to be disengaged from its matching profile.

The second cylindrical seat may be delimited on one side by a collar guiding the piston with respect to an internal cylindrical surface of the chamber.

After the piston has translated, the collar can be housed in a groove arranged at one end of the chamber.

The cylindrical surface, or first piston seat retaining the tips can incorporate a rib co-operating with a circular



groove arranged on the cylindrical surface of the internal bore so as to ensure the axial positioning of the piston in its retention position.

The device will advantageously incorporate at least  
5 three deformable tips evenly spaced angularly.

According to another embodiment of the invention, the first of the mechanical elements carrying the deformable tips may comprise a threaded part forming the shaft of a screw, the second mechanical element will thus constitute a  
10 head for said screw.

The pyrotechnic component will thus advantageously be integral with the screw head and the axial bore receiving the piston may be arranged in the screw shaft.

The axial bore may have an internal counter-sink  
15 forming an axial abutment for the piston when it is occupying its unlocking position.

The piston may incorporate a ring-shaped sealing ring co-operating with an internal cylindrical surface of the bore.

More specifically, the screw head may comprise a body  
20 delimiting an internal chamber that will be obturated on one side by the screw shaft and on the other by a plug that will press on a peripheral protuberance of the pyrotechnic component, a spacer ring surrounding an end of the  
25 pyrotechnic component and incorporating a first abutment surface co-operating with the protuberance on the component and a second abutment surface for an end of the screw shaft so as to avoid any contact between it and the pyrotechnic component when the plug is mounted.

According to another embodiment of the invention, the  
30 locking means may comprise at least two jaws each having a profile co-operating with a matching profile integral with the second mechanical element, each jaw being able to move radially in a radial housing integral with the first  
35 element so as to be engaged in or disengaged from the matching profile, such jaws being held in the locking position by the piston.

The external profile of the jaws will advantageously be a threaded profile.

The jaws may be held in contact with the piston by at least one flexible ring.

5       The piston may incorporate translation stop means ensuring its immobilisation with respect to the first mechanical element, such stop means being fractured when the pyrotechnic component is ignited.

10       The pyrotechnic component may be integral with the first mechanical element.

The second mechanical element may be formed by a nut co-operating with the threaded profile of the jaws.

15       According to another embodiment, the locking means may be formed by at least two balls that will be housed in holes arranged in a tubular sleeve integral with the first of the mechanical elements and co-operating with a groove integral with the second mechanical element, the balls being held in place by the piston, which will be positioned inside the tubular sleeve and coaxial to it.

20       The piston may, in this case, incorporate a cylindrical seat of the same diameter as the internal diameter of the sleeve, said cylindrical seat being located opposite the holes in the sleeve thanks to positioning means.

25       The positioning means may comprise a shearable plate integral with the piston and pressing on a front end of the sleeve.

30       The device may incorporate a chamber in which the gases generated by the pyrotechnic component will develop, said chamber arranged at one end of a head integral with the second mechanical element and obturated by the shearable plate.

The groove may be made in a ring that will be made integral with the second mechanical element by crimping a band.

35       According to a particular embodiment of the invention, the first mechanical element may be integral with one end of a rod of a master brake cylinder for a vehicle and the

second mechanical element will be integral with a brake pedal.

The invention will be better understood after reading the following description of the different embodiments, such description being made with reference to the appended drawings and in which:

- Figure 1 schematically represents the integration of an unlockable linking device according to one embodiment of the invention to link an automobile vehicle brake pedal and a master cylinder rod,

- Figure 2 shows a longitudinal section of a first embodiment of a linking device according to the invention, said section being made along the plane referenced BB in Figure 3,

- Figure 3 is a cross section of this device, said section being made along the plane referenced AA in Figure 2,

- Figure 4 shows a longitudinal section of a second embodiment of an unlockable linking device, said section being made along the plane referenced EE in Figure 5,

- Figure 5 is a view of the preceding device as a cross section along the plane referenced CC in Figure 4,

- Figure 6 shows a longitudinal section of a third embodiment of an unlockable linking device,

- Figure 7 is a view of the preceding device as a cross section along the plane referenced DD in Figure 6, the nut and plate having been removed,

- Figure 8 shows a longitudinal section of an unlockable linking device.

Figure 1 shows a brake pedal 1 of an automobile vehicle. This pedal is hinged with respect to the vehicle floor by a shaft 2. It acts on a rod 3 of a master brake cylinder 4 by means of an unlockable mechanical linking device 5.

A hinge (not shown, such as a fork joint) is provided between the device 5 and the rod 3 so as to allow the angular clearance of the pedal 1.

The unlockable mechanical linking device 5 is activated by control electronics 6 on the vehicle to which it is linked by a standard automobile connector 7 and a cable link 8.

5       The unlocking device 5 according to a first embodiment can be seen in detail in Figures 2 and 3.

It comprises a first mechanical element that is a tube 10 made integral by screwing to the end of the master cylinder rod 3.

10       The tube is housed in a bore 17 of a second mechanical element that is a cylindrical hub 11 incorporating a seat 12 of reduced diameter. This seat 12 is housed in a matching hole 13 arranged in the brake pedal 1. The hub 11 is made integral with the pedal 1 using a flexible ring 14  
15       that is positioned in a circular groove of the seat 12.

The brake pedal 1 is generally U-shaped and is made of bent sheet metal.

The two mechanical elements 10 and 11 are subjected to tensile and/or compressive forces along an axis 9.

20       The end of the tube 10 that is in the vicinity of the seat 12 incorporates four tips 15 separated by slits 16. The slits 16 are of a length selected so as to give the tips 15 a certain bending flexibility.

Each tip 15 incorporates a conical external profile 18  
25       that co-operates with a groove having a matching profile 19 and arranged in the bore 17 of the hub 11.

The four tips 15 are housed in the same conical groove 19.

30       The tips 15 delimit an internal cylindrical bore 20 in the tube in which a first cylindrical seat 22 of a piston 21 is positioned.

The piston 21 carries a pyrotechnic component 23 that is housed in a cavity of suitable dimensions. The pins 24 of the component are oriented in parallel to the axis 9 of  
35       the device and are directed towards a front face 25 of the device.

A housing 26 is arranged in the piston 21 and receives the connector 7 (see Figure 1) that is linked to the pins 24.

The pyrotechnic component 23 is intended to generate  
 5 gases that will fill a chamber 27 prolonging the cylindrical bore 20. This chamber is delimited by an internal cylindrical surface 28 of the tube 10 and it is closed on one side by the piston 21 and on the other by an end of the rod 3.

10 The piston 21 incorporates a second cylindrical seat of a lesser diameter than that of the first seat 22.

This second seat 29 is delimited on one side by a collar 30 guiding the piston 21 with respect to the internal cylindrical surface 28 of the chamber 27.

15 The diameter of the chamber 27 is greater than that of the cylindrical bore 20 delimited by the deformable tips.

This results in an abutment surface 32 by which the collar 30 will be stopped during the translation of the piston 21.

20 The second seat 29 is intended to be positioned opposite the bore 20 delimited by the tips 15 when the piston 21 is translated by the action of the gas pressure and abuts against the surface 32. It is thus of a length greater or equal to the tips 15.

25 A circular groove 31 is made between the cylindrical surface 28 of the chamber 27 and the cylindrical bore 20 delimited by the tips.

This groove is of a diameter selected so as to prevent any interference of the tips 15 with the collar 30 when  
 30 bending.

Lastly, a first cylindrical seat 22 of the piston 21 incorporates a rib 33 co-operating with a matching circular groove arranged in the cylindrical surface of the internal bore 20 as to ensure the axial positioning of the piston 21  
 35 in its retention position.

The device operates as follows.

In the locked position shown in Figures 2 and 3, the tube 10 and the hub 11 are integral in translation with one

another thanks to the locking means formed by the tips 15 integral with the tube 10 and co-operating with the matching conical profile 19 arranged on the hub 11.

These locking means are held in the locking position thanks to the retention means formed by the piston 21 whose first cylindrical seat 22 prevents the tips 15 from bending.

The co-operation of the rib 33 in its circular groove ensures the positioning of the piston 21 in its retention position and prevents any accidental displacement.

When the pyrotechnic component 23 has been ignited, the gas pressure that develops in the chamber 27 pushes the piston 21 towards the front face 25 of the device (in the direction indicated by arrow F in Figure 2).

In practical terms, the impulsion received by the piston when the component is ignited is enough to push the piston.

It is therefore unnecessary to provide gas tightness means for the slits 16. According to the characteristics of the pyrotechnic component a flexible plastic material or grease may nevertheless be placed in the slits so as to improve gas tightness and allow the pressure to build up in the chamber 27.

The piston 21 is displaced until the collar 30 abuts on the abutment surface 32. At this point, the second cylindrical seat 29 of the piston 21 is positioned opposite the bore 20 delimited by the tips 15.

The diameter of this second seat is less than that of the first seat 22 and is selected small enough for the radial deformation of the tips 15 to continue until their conical external profile 18 is disengaged from its matching housing 19.

The tube 10 can then translate with respect to the hub 11 following direction F, which will occur when a force of a certain strength is applied to the pedal 1 in a direction G (compressive force).

It will be noted that the tips 15 may be dimensioned such that the force causing the separation is of a given

strength (of around 150 daN). This will allow the brake to be manoeuvred in the event of the accidental ignition of the pyrotechnic component.

When the force exerted exceeds the predetermined level,  
 5 the tips will be disengaged from their housing, causing the pedal and master cylinder rod to become separated and thus protecting the driver from injuries caused by the pedals.

It is easy for the person skilled in the art to dimension the tips 15 according to the force required to  
 10 cause separation. It is possible to act upon:

- the depth of the grooves 16, deep grooves providing increased flexibility,
- the angle of conical profiles 18 and 19, an increase in the cone angle increasing the disengagement  
 15 force,
- the width of the conical groove 19, a wide groove requiring bending and thus a greater force in order to disengage the tips,
- the width of each tip and the number of tips,  
 20 narrow tips being able to bend under a lesser force.

The abutment surface 32 prevents the piston 21 from being ejected from the device thereby avoiding potential injuries.

Different variations are possible without departing  
 25 from the scope of the invention.

It is thus possible to vary the number of tips 15.

It is also possible for the conical external profiles to be replaced by different profiles, for example spherical profiles.

30 It is also possible for the single cone profile 18 to be replaced by a profile formed of consecutive cones having a common base. Such an arrangement (as indeed that implementing spherical profiles) will allow a device to be made that is able to separate under the effect of either a  
 35 tensile or compressive force.

In this case, each cone may be given a different angle and/or a different matching profile length on the hub, thereby ensuring a separation force having different

strengths in the tensile direction and the compression direction.

Figure 4 shows a second embodiment of a linking device according to the invention.

5 This unlockable linking device 5 allows a pyrotechnic screw 69 to be formed that provides a mechanical link between two mechanical elements not shown. The screw 69 comprises a head 67 and a threaded part 68 or screw shaft.

Conventionally, the threaded part 68 shall be made  
10 integral with a mechanical element (not shown) whereas the head 67 will press on another mechanical element (not shown).

According to this particular embodiment, the unlockable linking device 5 will thus allow a first mechanical element  
15 comprising a threaded shaft 68 and a second mechanical element formed by the head 67 to be separated.

In an analogous manner to the previous embodiment described with reference to Figures 2 and 3, the first mechanical element 68 carries four deformable tips 15  
20 evenly spaced angularly and separated by slits 16 that may be filled with grease to improve gas tightness.

Each tip 15 incorporates a conical external profile 18 that co-operates with a matching profile 19 arranged in a body 70 of the head 67.

25 The four tips delimit an internal cylindrical bore 20 that receives the piston 21.

The axial bore 20 is prolonged inside the screw shaft 68 and has an internal counter-sink 71 forming an axial abutment for the piston 21 when the latter is translated  
30 and occupies its unlocking position.

An axial channel 72 prolongs the bore 20 and allows the air in the bore 20 to be evacuated when the piston 21 is displaced. The piston 21 incorporates a sealing ring 73 placed in a groove and co-operating with an internal  
35 cylindrical surface of the bore 20. This sealing ring is intended to provide gas tightness means for the pyrotechnic component 23.



The pyrotechnic component 23 is placed in an internal chamber 74 delimited by the body 70 of the screw head 67.

It is held in place by a plug 75 screwed in a female thread 76 in the body 70 and pressing by a countersink 77  
 5 on a peripheral protuberance 78 on the pyrotechnic component 23.

A spacer ring 79 surrounds one end of the pyrotechnic component 23 and incorporates a first abutment surface 80 co-operating with the protuberance 78 of the pyrotechnic  
 10 component 23 and a second abutment surface 81 on which an end 82 of the screw shaft 68 presses.

Thus, when the screw is mounted, screwing the plug 75 onto the body 70 causes the axial immobilisation of the pyrotechnic component 23, which is pinched between the plug  
 15 75 and the spacer ring 79. Such an arrangement also avoids any contact between the end 82 of the screw shaft 68 and the pyrotechnic component 23. Any deterioration to the component when mounting the screw is thereby avoided.

Screwing the plug 75 also allows a mechanical bias to  
 20 be exerted, by means of the ring 79, on the deformable tips 15 that are applied onto the conical profile 19.

The external profile of the body 70 of the head is, here, a hexagonal profile but any other profile allowing tightening to be carried out using a tool may be envisaged  
 25 (square, cylindrical with notches for a chuck key...).

This pyrotechnic screw is mounted as follows:

First of all, the piston is positioned in the bore 20 of the screw shaft 68 in the locking position of the tips  
 15.

30 The screw shaft 68 is thereafter introduced into the body 70 of the head. The diameter of the hole passing through the head 70 is naturally greater than that of the screw shaft 68. The tips 15 are thus in abutment against the conical internal profile 19 of the head body 70.

35 Lastly, the plug 75 carrying the pyrotechnic component 23 and the spacer ring 79 is screwed onto the body 70.

The plug (fitted with means allowing a tool having faces or notches to be engaged) is screwed until the ring

79 abuts against the end 82 of the screw shaft 68. A mechanical bias is given during this tightening so as to apply the tips 15 firmly against the conical profile 19 thereby aiding their deformation when the device is  
5 unlocked.

This device operates as follows.

When the pyrotechnic component 23 has been ignited, the gases generated push the piston 21 towards the bottom of the bore 20 until it abuts against the countersink 71.

10 The depth of the bore 20 is enough for the piston 21, when in this unlocked position, no longer to be opposite the deformable tips 15.

As the axial forces tend to push away the shaft 68 and the head 67, that is to say the usual forces due to  
15 tightening a screw, this will result in the deformation of the tips 15, which will be pushed away by the conical profile 19.

The screw shaft 68 will then separate from the screw head 67. The separation is made easier by the initial  
20 mechanical bias given by tightening the plug 75 when the device is mounted.

It is naturally possible to vary the number of tips 15 in such an embodiment.

Such an unlockable linking device may be used in any  
25 application as simply as a normal screw. It ensures separation further to a tensile force exerted between the shaft and the screw head.

Such a screw or device may be used, for example, to link an air-deliverable load to an aircraft.

30 Figure 6 shows a third embodiment of a linking device according to the invention.

This unlockable linking device also constitutes a pyrotechnic screw 5 that allows a first mechanical element 10, which here is a tube attached at a rear cylindrical  
35 part of the screw 5, for example by threading, to be linked to a second mechanical element comprising a plate 34 held by a nut 36.

Within the scope of a particular application, the tube 10 may be integral with the carrier of an air-deliverable charge, for example an aircraft, and the plate integral with an airborne load such as a fuel tank or bomb. In this case, this device would allow the separation of the load and the aircraft to be commanded at a given time.

The pyrotechnic screw 5 presses on the plate 34 at a shoulder 35 and the second mechanical element comprises the nut 36 co-operating with the screw 5. The nut 36 is a conventional hexagonal nut that is applied to the plate 34 by screwing.

The screw 5 comprises a body 37 that has an axial housing intended to receive a pyrotechnic component 23.

The body 37 incorporates a rear cylindrical part 37a onto which the tube 10 and a hexagonally-profiled front part 37b (see Figure 7) is screwed so as to make screwing easier using conventional tooling (wrenches).

The axial housing of the body incorporates a conical abutment surface 38 that co-operates with a protuberance 39 on the component 23. The axial housing incorporates a female thread 40 that receives a threaded support 41 incorporating two cylindrical parts 41a and 41b separated by the shoulder 35.

The support 41 is sectioned by an axial bore 42 prolonged on the body 37 side by a countersink 43 capping the pyrotechnic component 23.

Thus, the pyrotechnic component 23 is pinched and immobilised between the support 41 and the body 37.

The support 41 also has a transversal groove 44 that passes right through the cylindrical part 41a, perpendicularly to the axis of the bore 42.

This groove thus forms two housings in the support 41 that each receive, in a radially sliding manner, a jaw 45 having a shape matching that of its housing.

The groove may be of a rectangular shape or else, more advantageously, a milled groove ended by two semi-cylindrical portions.

Each jaw 45 has a threaded external profile 45a that is intended to co-operate with the nut 36 and a cylindrical-portioned internal profile 45b intended to co-operate with a piston 21.

5       The piston 21 is of the same diameter as the bore 42 and is thus guided by this bore on either side of the grooves 44.

      The jaws 45 are held in contact with the piston 21 by a flexible ring 46 housed in matching grooves made in the  
10       jaws 45.

      The ring 46 is, for example, a split ring made of metal or a plastic material. It retains the jaws before a nut is screwed in placed.

      The external diameter of the cylindrical part 41a of  
15       the support 41 is slightly less than the diameter at the crest of the female thread of the nut 36.

      It is thus possible for the nut to slide on the cylindrical part 41a without sticking.

      The jaws are dimensioned such that when they are held  
20       against the piston 21 by the ring 46, they both protrude from their grooves 44 by a length such that their threaded profile 45a fully corresponds to the female threading of the nut 36 (see Figure 7).

      Lastly, the piston 21 carries translation stopping  
25       means 47 ensuring its axial immobilisation with respect to the support 41, and thus with respect to the first mechanical element 10.

      These stopping means are formed, for example, by a ring of plastic material, such as a polyamide or else rubber  
30       placed in a circular groove of the piston 21.

      The selection of rubber for this also allows the gas tightness of the assembly to be reinforced with respect to the gases generated by the pyrotechnic component. The ring will be fractured when the pyrotechnic component is ignited  
35       so as to allow the piston to translate.

      This linking device operates as follows.

When the pyrotechnic component 23 has been ignited, the gases generated push the piston 21 in its bore and eject it from the screw 5.

The jaws 45 are no longer held radially by the piston.  
 5 Thus, an axial force between the screw 5 and the nut 36 (thanks to the co-operation of the threaded profiles of the jaws and nut) will result in the jaws 45 being pushed towards the inside of the axial bore 42.

The screw 5 thereafter separates from the nut 36.

10 It is naturally possible to vary the number of jaws 45 in such an embodiment.

An external profile 37b may also be given to the body 37 that is different in shape: square, cylindrical with notches to allow tightening.

15 Such an unlockable linking device may be used in any application as simply as a normal screw.

It also mechanical element subjected to tensile forces to be separated. Such a screw or device may, for example, be used to link an air-deliverable load to an aircraft.

20 Figure 8 shows an unlockable linking device according to a fourth embodiment of the invention.

This device links a first mechanical element, which here is a rod 10 (to the left of this Figure), and a second mechanical element 49 (to the right of the Figure), which  
 25 here is a hollow rod.

According to this embodiment, the locking means are formed by balls 48 housed in radial holes 50 arranged in a tubular end 51 of the first mechanical element 10.

The linking device comprises a head 52, fastened to an  
 30 end of the hollow rod of the second element 49, for example, by radial screws (only one axis 53 of which is shown).

The head 52 receives a pyrotechnic component 23 fastened in a countersink 54 arranged in the head 52 by  
 35 ring-shaped crimping 55. This component is connected by wires, not shown, to electronic activation control means. The wires pass through the hollow rod 49, for example through a side opening 66.

The holes 50 receiving the balls 48 are evenly spaced angularly on the tubular end 51 of the first element 10.

At least two balls will be provided (here four balls have been used).

5       The balls co-operate here with a groove 56 delimited by the conical profiles 57a, 57b and made in a ring 58.

The ring 58 is made integral with the head 52, and thus with the second mechanical element 49, by crimping a cylindrical metal band 59. Crimping is carried out, firstly  
10       at a peripheral shoulder 60 of the head 52 and secondly, on an end 61 of the ring 58.

According to this particular embodiment, the balls 48 are retained by a piston 21 placed inside the tubular end 51 and coaxially to it.

15       The piston 21 incorporates a cylindrical seat 62 of the same diameter as the internal diameter of the tubular end 51 forming a sleeve. The cylindrical seat 62 is held opposite the holes 50 thanks to positioning means 63.

The positioning means 63 comprise a shearable plate  
20       integral with the piston, for example, by bonding and which presses on a front end of the first element 10.

The shearable plate 63 is held pinched between the ring 58 and the head 52.

The plate will, for example, be made of a light alloy  
25       or else of a plastic material whereas the piston may be made of steel. The ring 58 will, for example, be made of steel.

This device is assembled as follows:

- first of all the ring 58 is positioned alone  
30       opposite the holes 50,

- the balls 48 are placed in the holes, they will be temporarily held in place, for example, by grease,

- the piston 21, which retains the balls, is set into place,

35       - the equipped head 52 of the component 23 is set into place,

- the band 59 is set into place and is made integral by crimping the ring 59 and the head 52.

After assembly, the device incorporates a chamber 64 in which the gases generated by the pyrotechnic component 23 will develop.

The chamber is arranged in the head 52 and is obturated  
5 by the shearable plate 63.

This device operates as follows.

When the pyrotechnic component 23 has been ignited, the gases cause the plate 63 to be sheared and push the piston 21 in the internal cavity 65. The relative lengths of the  
10 piston and cavity will be selected such that, when the piston abuts at the cavity 65 bottom, the cylindrical surface 62 is no longer in front of the holes 50 which receive the balls 48.

These latter are no longer held radially in contact  
15 with the groove 56. A tensile and/or compressive force along directions F1 or F2 will therefore cause the balls to be ejected towards the inside of the cavity 65 because of the co-operation of the conical profiles 57a, 57b of the groove with the balls. The two elements 10 and 49 are thus  
20 separated.

In this as in the previous embodiments, the advantages of the invention lies in that the pyrotechnic component acts on an element (the piston 21 carried by the plate 63), which does not participate in the transmission of forces  
25 between the first mechanical element 10 and the second mechanical element 49.

It is thus possible to have an extremely rigid mechanical link between these two element whilst ensuring the easy, reliable and fast separation of these two  
30 elements using a component implementing a reduced mass of pyrotechnic composition. Indeed, the pyrotechnic component does not have to fracture a mechanical element ensuring the transmission of the tensile and/or compressive forces, but has only to fracture a plate 63 whose thickness may be  
35 relatively reduced. After displacement of the means (the piston) ensuring the retention of the locking means (the balls), a reduced tensile or compressive force on one of

other of the mechanical elements 10 or 49 will eject the locking means 48 and separate the two elements.

The plate 63 may also incorporate an incipient fracture, for example a ring-shaped groove.

5        Such a device is unlocked both when subjected to a tensile force (direction F1) and when subjected to a compressive force (direction F2). It may thus be used as that shown in Figures 2 and 3 to connect a brake rod to a brake pedal (compressive force). It may also, similarly to  
10 the pyrotechnic screws shown in Figures 4 to 7, be used to connect a load to a carrier (tensile force).

By way of a variant, it is once again possible for a profile matching that of the balls to be selected for the groove 56 that has a different shape, for example a  
15 circular section profile of the same diameter as that of the balls.



**CLAIMS**

1. A pyrotechnically unlockable mechanical linking device (5) between two mechanical elements likely to be subjected to tensile and/or compressive forces along an axis, said device comprising at least one pyrotechnic component (23) and at least one locking means (15, 45, 48) linking the two mechanical elements along at least one axis, said locking means able to be released when the mechanical elements are subjected to tensile and/or compressive forces along said axis and held in the locking position by retention means (21) that are released by the pressure of gases generated by igniting the pyrotechnic component (23), device wherein the retention means comprise a piston (21) able to slide in an axial bore (20, 42, 65) under the effect of the gas pressure generated by the pyrotechnic component (23), the locking means (15, 45, 48) being in contact with the piston (21) at its external cylindrical surface, which ensures their retention in the locking position.
2. An unlockable mechanical linking device according to Claim 1, wherein the locking means (15) are linked in translation with a first (10, 68) of the mechanical elements and comprise at least one profile (18) co-operating with a matching profile (19) integral with a second (11, 67) of the mechanical elements, the locking means (15) also delimiting at least partially the axial bore (20) in which the piston (21) can slide.
3. An unlockable mechanical linking device according to Claim 2, wherein the locking means comprise at least two deformable tips (15) integral with the first (10, 68) of the mechanical elements and each comprising at least one profile (18) co-operating with a matching profile (19) integral with the second (11, 67) mechanical element, such tips delimiting the internal cylindrical bore receiving the piston (21).
4. An unlockable mechanical linking device according to Claim 3, wherein the tips (15) have conical external profiles (18).

5. An unlockable mechanical linking device according to one of Claims 3 or 4, wherein the pyrotechnic component (23) is integral with the piston (21).

6. An unlockable mechanical linking device according to  
5 Claim 5, wherein the cylindrical bore (20) delimited by the tips (15) is extended by a chamber (27) intended to receive the gas pressure generated by igniting the pyrotechnic component (23).

7. An unlockable mechanical linking device according to  
10 one of Claims 5 or 6, wherein the piston (21) incorporates a second cylindrical seat (29) of a diameter less than that of the cylindrical surface (22) or first seat retaining the tips, said second seat being positioned opposite the bore (20) delimited by the tips (15) when the piston (21) is  
15 translated under the action of the gas pressure, thereby allowing the tips (15) to bend in the direction of the piston (21), such bending allowing the external profile (18) of the tips (15) to be disengaged from its matching profile (19).

20 8. An unlockable mechanical linking device according to Claim 7, wherein the second cylindrical seat (29) is delimited on one side by a collar (30) guiding the piston (21) with respect to an internal cylindrical surface (28) of the chamber (27).

25 9. An unlockable mechanical linking device according to Claim 8, wherein, after the piston (21) has translated, the collar (30) is housed in a groove (31) arranged at one end of the chamber (27).

30 10. An unlockable mechanical linking device according to one of Claims 3 to 9, wherein the cylindrical surface (22), or first piston seat retaining the tips incorporates a rib (33) co-operating with a circular groove arranged on the cylindrical surface of the internal bore (20) so as to ensure the axial positioning of the piston (21) in its  
35 retention position.

11. An unlockable mechanical linking device according to one of Claims 3 to 10, wherein it incorporates at least three deformable tips (15) evenly spaced angularly.

12. An unlockable mechanical linking device according to one of Claims 2 to 4, wherein the first of the mechanical elements carrying the deformable tips (15) comprises a threaded part (68) forming the shaft of a screw, the second mechanical element constituting a head (67) for said screw.

13. An unlockable mechanical linking device according to Claim 12, wherein the pyrotechnic component (23) is integral with the screw head (67).

10 14. An unlockable mechanical linking device according to one of Claims 12 or 13, wherein the axial bore (20) receiving the piston (21) is arranged in the screw shaft (68).

15 15. An unlockable mechanical linking device according to Claim 14, wherein the axial bore (20) has an internal counter-sink (71) forming an axial abutment for the piston (21) when it is occupying its unlocking position.

20 16. An unlockable mechanical linking device according to one of Claims 14 or 15, wherein the piston (21) incorporates a ring-shaped sealing ring (73) co-operating with an internal cylindrical surface of the bore (20).

25 17. An unlockable mechanical linking device according to one of Claims 13 to 16, wherein the screw head (67) comprises a body (70) delimiting an internal chamber (74) that is obturated on one side by the screw shaft (68) and on the other by a plug (75) that presses on a peripheral protuberance (78) of the pyrotechnic component (23), a spacer ring (79) surrounding an end of the pyrotechnic component (23) and incorporating a first abutment surface (80) co-operating with the protuberance (78) on the component and a second abutment surface (81) for an end (82) of the screw shaft (68) so as to avoid any contact between it and the pyrotechnic component (23) when the plug (75) is mounted.

35 18. An unlockable mechanical linking device according to Claim 2, wherein the locking means comprise at least two jaws (45) each having a profile co-operating with a matching profile integral with the second mechanical

element, each jaw (45) being able to move radially in a radial housing (44) integral with the first element so as to be engaged in or disengaged from the matching profile, such jaws being held in the locking position by the piston  
 5 (21).

19. An unlockable mechanical linking device according to Claim 18, wherein the external profile of the jaws (45) is a threaded profile.

20. An unlockable mechanical linking device according  
 10 to one of Claims 18 or 19, wherein the jaws (45) are held in contact with the piston (21) by at least one flexible ring (46).

21. An unlockable mechanical linking device according to one of Claims 18 to 20, wherein the piston (21)  
 15 incorporates translation stop means (47) ensuring its immobilisation with respect to the first mechanical element, such stop means being fractured when the pyrotechnic component (23) is ignited.

22. An unlockable mechanical linking device according  
 20 to one of Claims 18 to 21, wherein the pyrotechnic component (23) is integral with the first mechanical element.

23. An unlockable mechanical linking device according to one of Claims 19 to 22, wherein the second mechanical  
 25 element is formed by a nut (36) co-operating with the threaded profile of the jaws (45).

24. An unlockable mechanical linking device according to Claim 1, wherein the locking means are formed by at least two balls (48) that are housed in holes (50) arranged  
 30 in a tubular sleeve (51) integral with the first (10) of the mechanical elements and co-operating with a groove (56) integral with the second mechanical element (49), the balls (48) being held in place by the piston (21), which is positioned inside the tubular sleeve (51) and coaxial to  
 35 it.

25. An unlockable mechanical linking device according to Claim 24, wherein the piston (21) incorporates a cylindrical seat (62) of the same diameter as the internal

diameter of the sleeve, said cylindrical seat being located opposite the holes (50) in the sleeve thanks to positioning means (63).

26. An unlockable mechanical linking device according  
5 to Claim 25, wherein the positioning means comprise a shearable plate (63) integral with the piston (21) and pressing on a front end of the sleeve.

27. An unlockable mechanical linking device according  
to Claim 26, wherein it incorporates a chamber (64) in  
10 which the gases generated by the pyrotechnic component (23) develop, said chamber arranged at one end of a head (52) integral with the second mechanical element (49) and obturated by the shearable plate (63).

28. An unlockable mechanical linking device according  
15 to one of Claims 24 to 27, wherein the groove (56) is made in a ring (58) that is made integral with the second mechanical element (49) by crimping a band (59).

29. An unlockable mechanical linking device according  
to one of Claims 1 to 11 or 24 to 28, wherein the first  
20 mechanical element is integral with one end of a rod of a master brake cylinder for a vehicle and the second mechanical element is integral with a brake pedal.

## ABSTRACT OF DISCLOSURE

The invention relates to a pyrotechnically unlockable mechanical linking device between two mechanical elements likely to be subjected to tensile and/or compressive forces along an axis.

This device comprises at least one pyrotechnic component (23) and at least one locking means (15) linking the two mechanical elements along at least one axis, said locking means held in the locking position by retention means (21) that are released by the pressure of gases generated by igniting the pyrotechnic component (23).

This device is characterised in that the retention means comprise a piston (21) able to slide in an axial bore (20) under the effect of the gas pressure generated by the pyrotechnic component (23), the locking means (15) being in contact with the piston (21) at its external cylindrical surface, which ensures their retention in the locking position.

Application to safety systems for automobiles.

-Fig. 2-

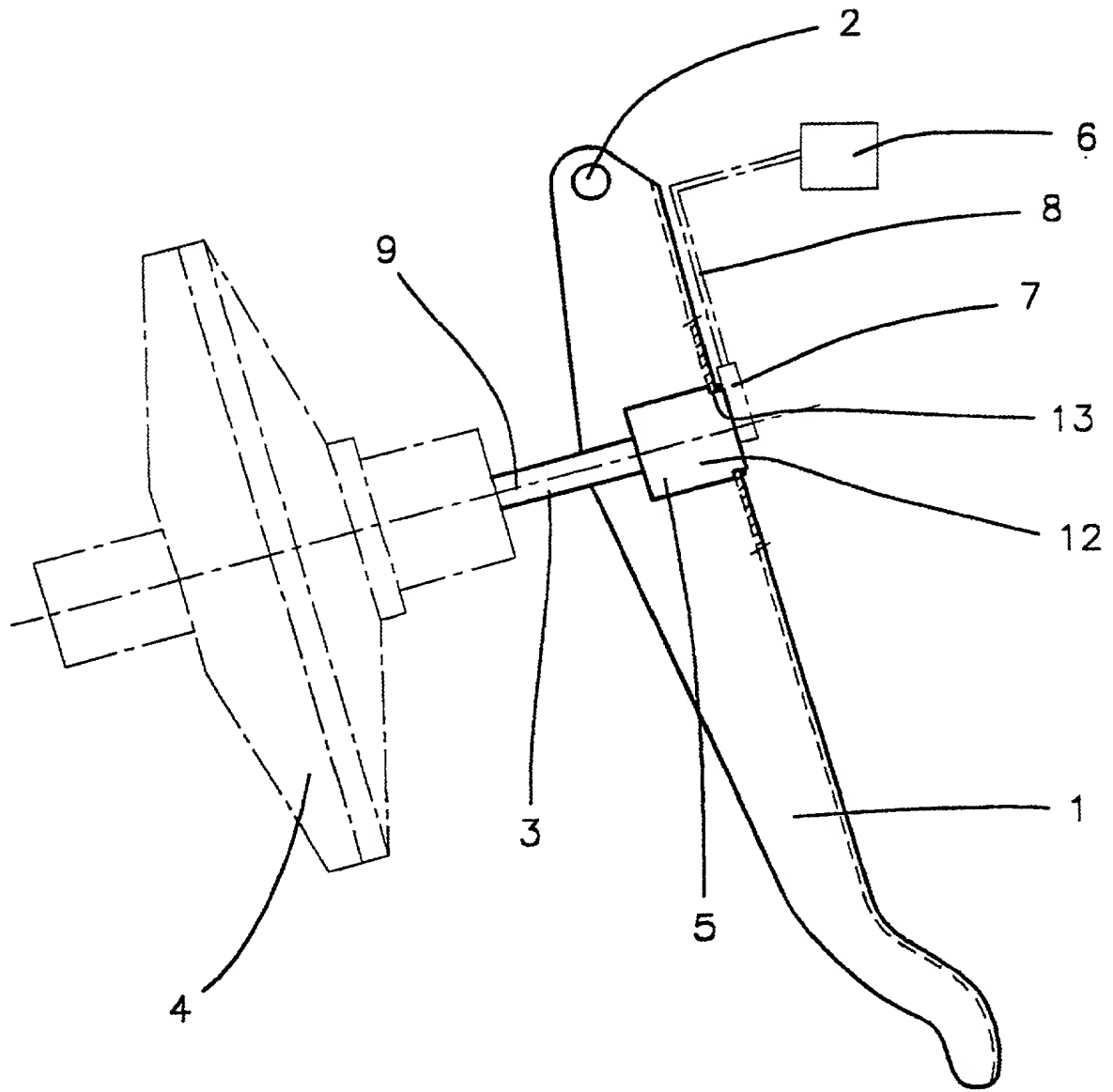


FIG 1

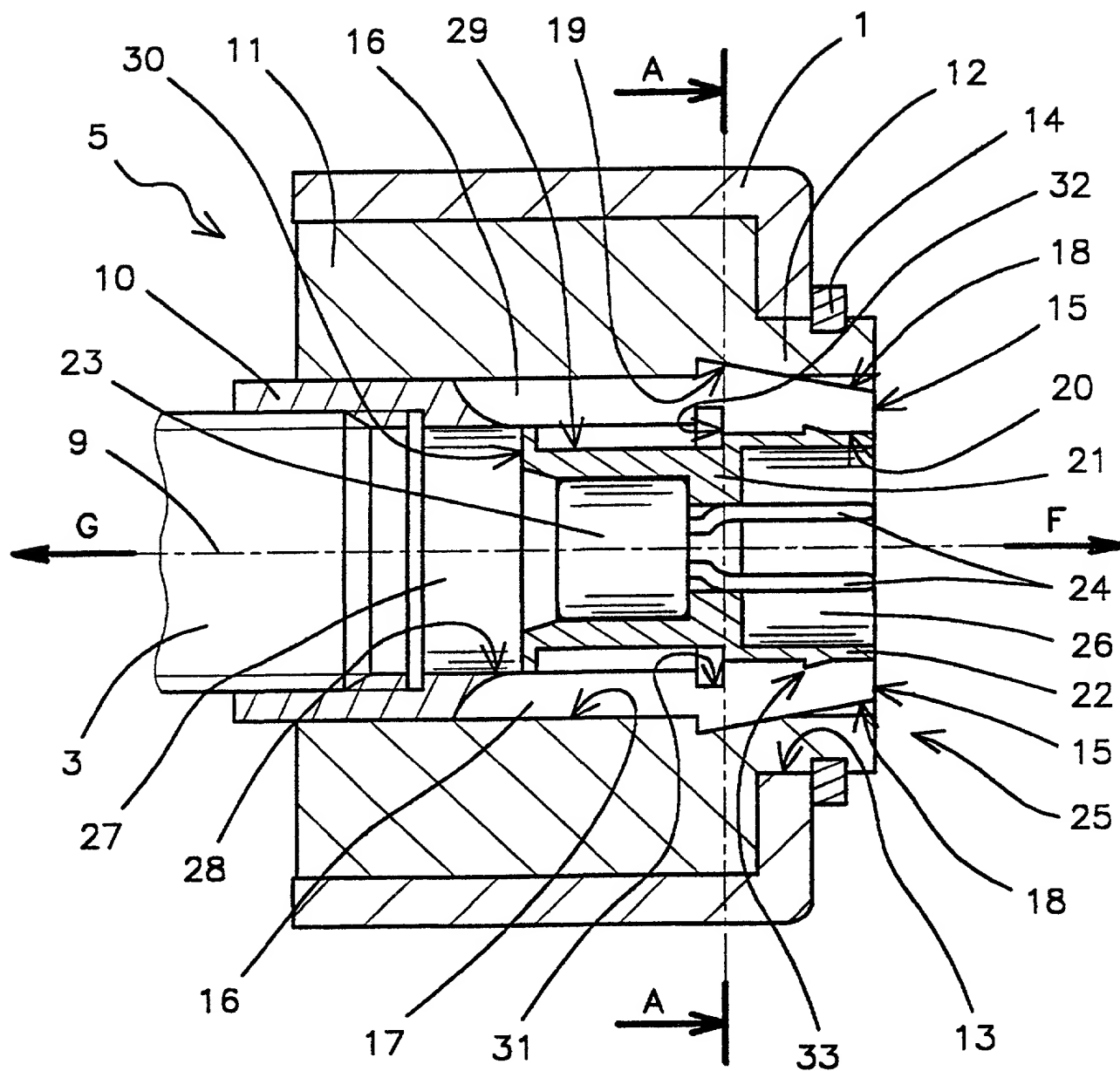


FIG 2



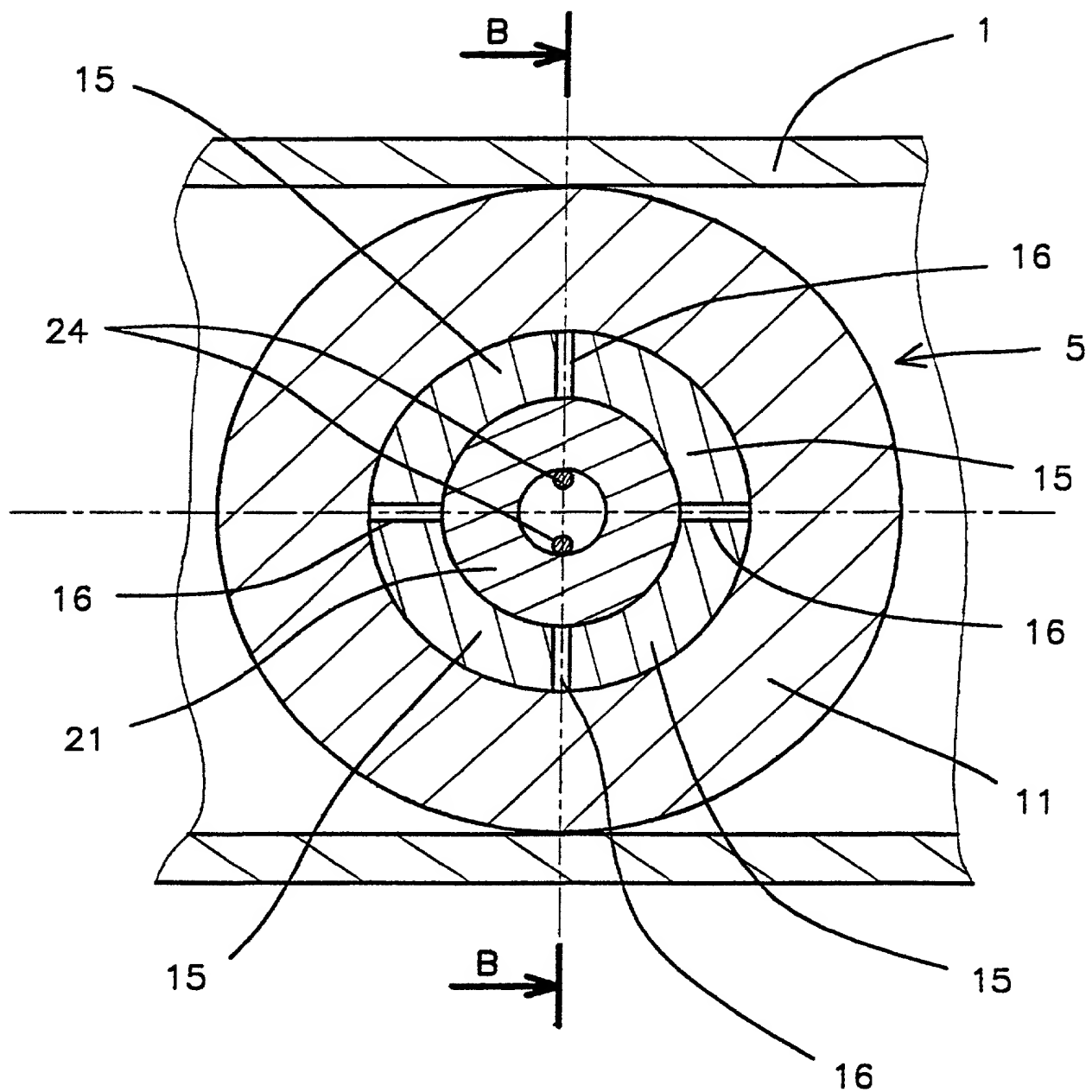


FIG 3

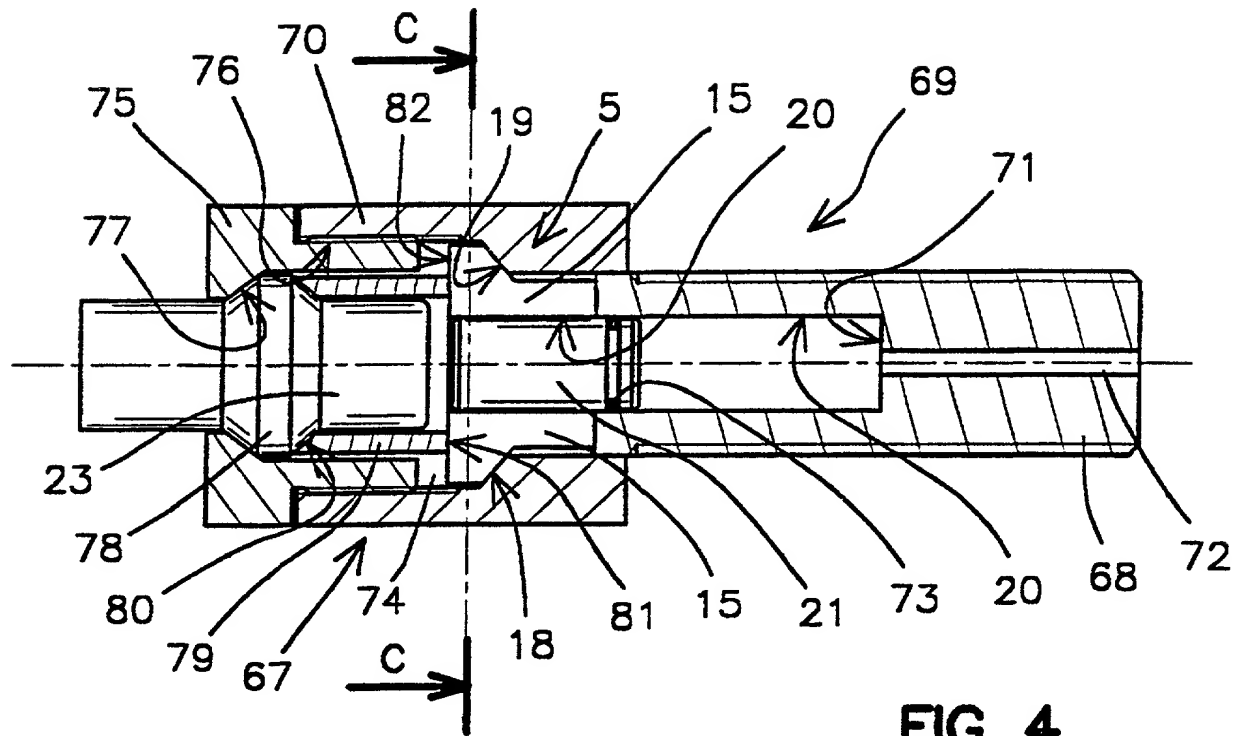


FIG 4

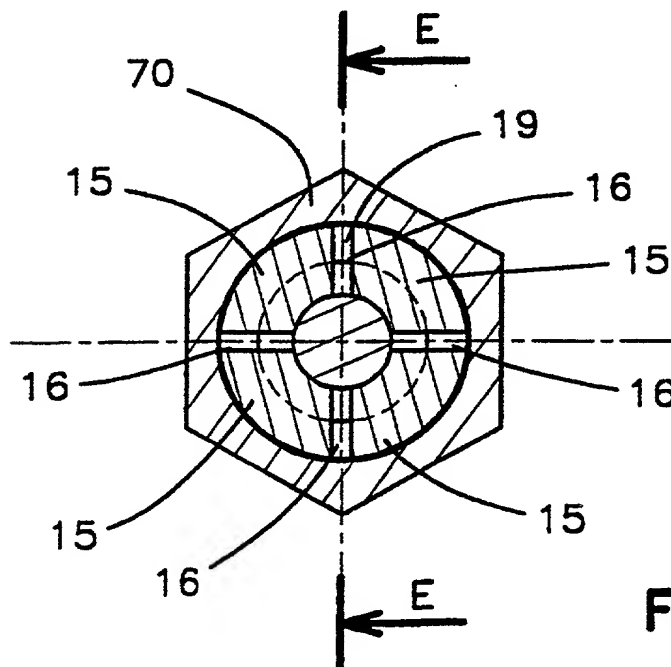


FIG 5

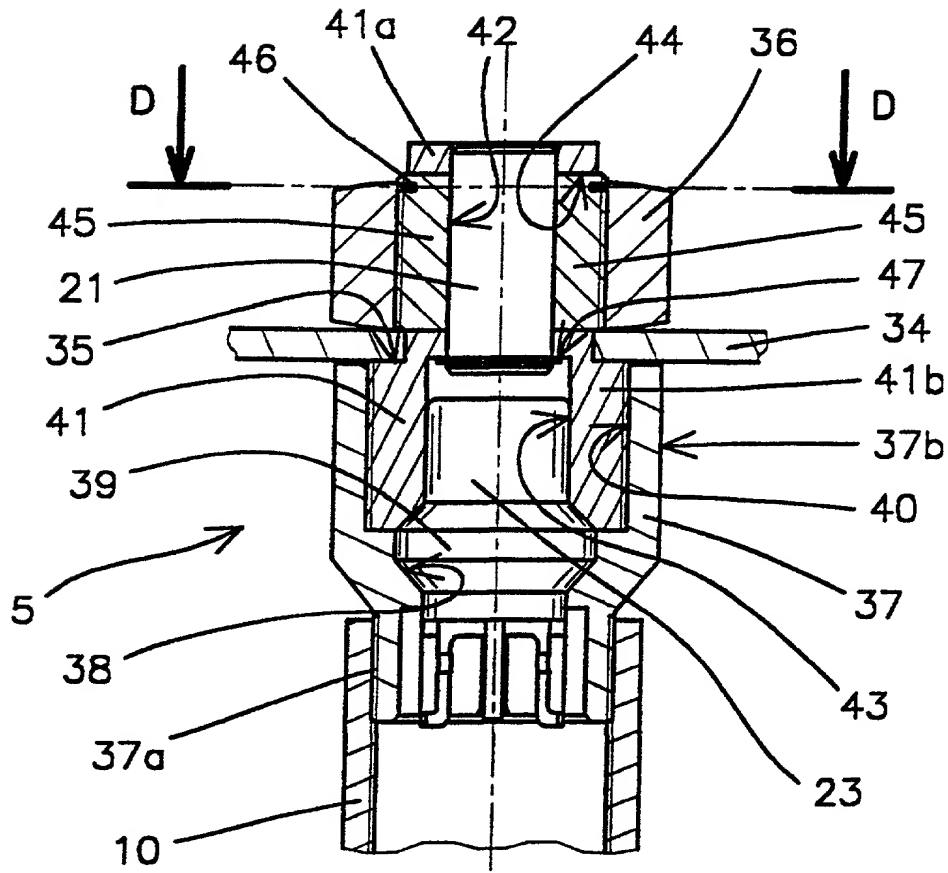


FIG 6

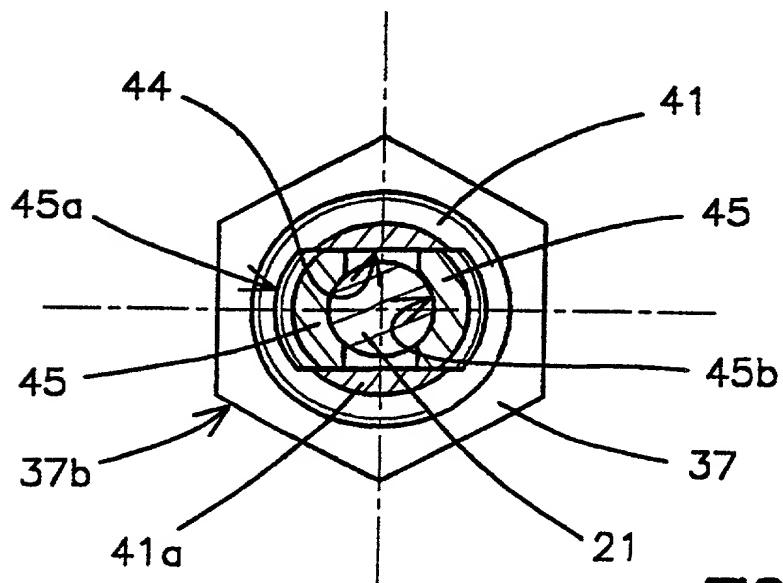


FIG 7

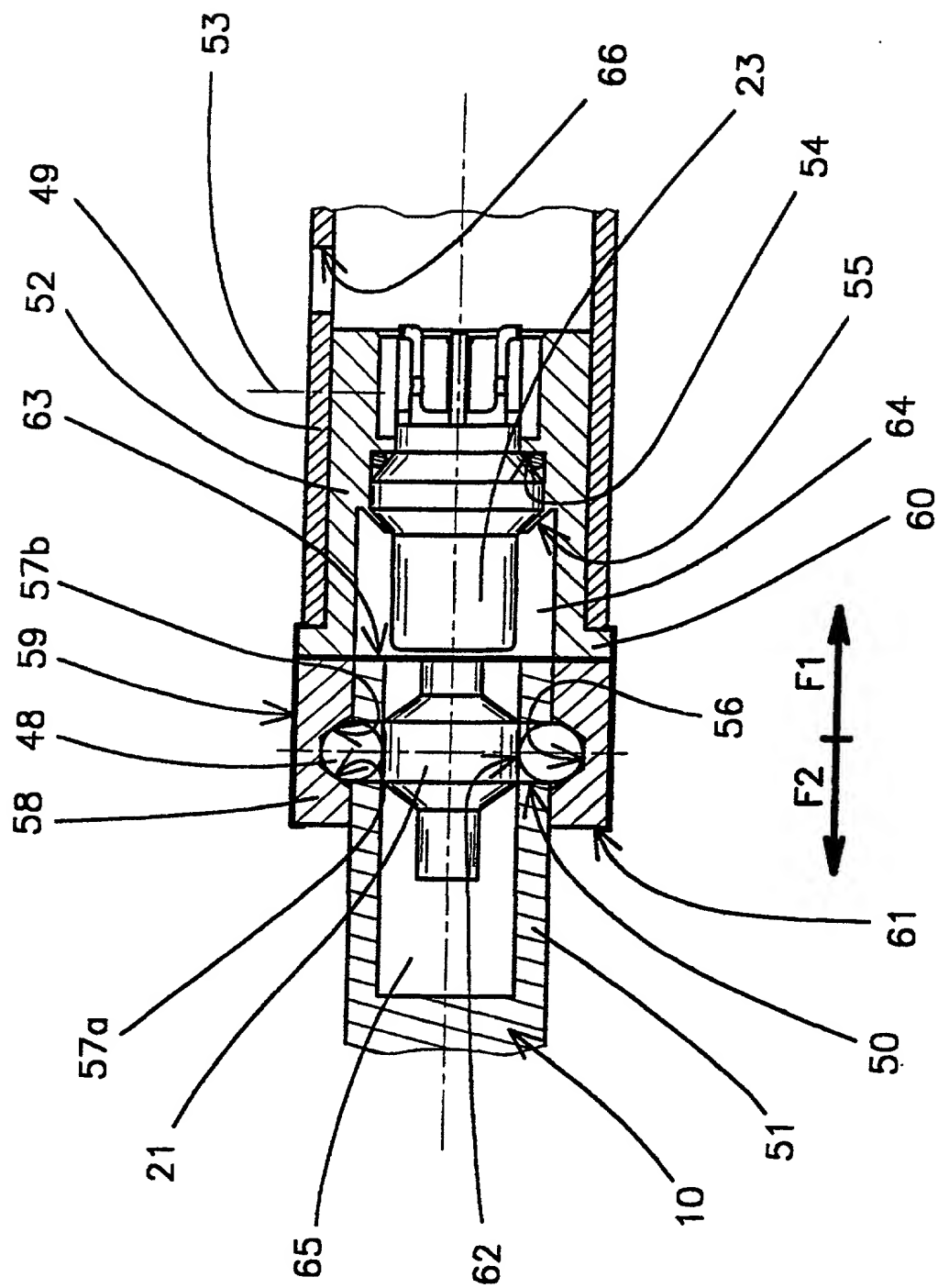


FIG 8

**DECLARATION AND POWER OF ATTORNEY  
UNDER 35 USC §371(c) (4) FOR  
PCT APPLICATION FOR UNITED STATES PATENT**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the invention entitled : PYROTECHNICALLY UNLOCKABLE MECHANICAL

DEVICE IMPLEMENTING A PISTON

Described and claimed in international application number **PCT/FR99/03066** filed on **December 9, 1999**.


I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information of which I am aware which is material to the examination of the application in accordance with Title 37, Code of Federal Regulations, §1.56.

Under title 35, U.S. §119, the priority benefits of the following foreign application(s) filed by me or my legal representatives or assigns, within one year prior to my international application are hereby claimed:


**French Patent Application No 98.15637 filed on December 9, 1998**

The priority of the above applications (if any), filed within a year prior to my international application is hereby claimed under 35 USC 119. I hereby appoint the following as my attorneys of record with full power of substitution and revocation to prosecute this application and to transact all business in the Patent Office:

 **Roger W. Parkhurst, Reg. No. 25,177 ; and/or Charles A. Wendel, Reg. No. 24,453.**

**ALL CORRESPONDENCE IN CONNECTION WITH THIS APPLICATION SHOULD BE SENT TO :  
PARKHURST & WENDEL, L.L.P., 1421 PRINCE STREET, SUITE 210, ALEXANDRIA, VIRGINIA 22314-  
2805 - TELEPHONE (703) 739-0220**

I hereby declare that I have reviewed and understand the contents of this Declaration, and that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1 **Typewritten Full Name**  
**Of First or Sole Inventor**  Jean-Paul VIDOT  
Given Name Middle Initial Family Name

2 **\*\*Inventor's Signature:** Jean Paul VIDOT

3 **\*\*Date of Signature:** 2001 / 05 / 31  
Month Day Year

Residence: Bordères sur l'Echez FR France  
City State or Province Country

Citizenship: French

Post Office Address:  
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\*If Box (a.) is checked, this form may be executed only when attached to the specification (including claims).

\*\*Note to Inventor: Please sign name exactly as it appears above and insert actual date of signing.

IF THERE IS MORE THAN ONE INVENTOR USE PAGE 2 AND PLACE AN "X" HERE ☒

**PAGE 2 OF U.S.A. DECLARATION FORM**  
**(Discard this page in a sole inventor application)**

**Typewritten Full Name  
Of First or Sole Inventor**

200

**Patrice**

Given Name

Middle Initial

**CHEMIERE**

Family Name

**\*\*Inventor's Signature:**

*Patrice*

*CHEMIERE*

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*2001/05/31*

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**Typewritten Full Name  
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Month

Day

Year

Residence:

City

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Citizenship:

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mailing address,  
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**Typewritten Full Name  
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of First or Sole Inventor**

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Middle Initial

Family Name

**\*\*Inventor's Signature:**

**\*\*Date of Signature:**

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Year

Residence:

City

State or Province

Country

Citizenship:

Post Office Address:

(Insert complete  
mailing address,